CHARACTERIZATION OF STANDARDIZED LUNAR REGOLITH SIMULANT MATERIALS. P. Carpenter[1], L. Sibille[1], G. Meeker[2], and S. Wilson[2], [1]BAE Systems, Marshall Space Flight Center, AL 35812, paul.k.carpenter@nasa.gov, [2]United States Geological Survey, MS964, Lakewood CO 80025.

Introduction: Lunar exploration requires scientific and engineering studies using standardized testing procedures that ultimately support flight certification of technologies and hardware. This motivates the development of traceable, standardized lunar regolith simulant (SLRS) materials. For details, refer to the 2005 Workshop on Lunar Regolith Simulant Materials [1].

Lunar Regolith Simulants: A lunar regolith simulant is manufactured from terrestrial components for the purpose of simulating the physical and chemical properties of the lunar regolith. The 2005 Workshop recommended production of two root simulants corresponding to a low-Ti mare basalt and a high-Ca highland anorthosite. These roots represent compositional end-members of mare and highland materials, and can in principle be physically mixed to target the range of soil compositions in the Apollo inventory. Lunar mare basalt simulant JSC-1A approximates Apollo 14 basalts with relatively low-Ti content, and was obtained by milling and sieving a glassy volcanic ash from Merriam Crater in Arizona (Fig. 1). Simulant JSC-1A has a grain size distribution similar to typical Apollo regolith samples, and a fine fraction JSC-1AF has been further milled to achieve a ~ 25 μm median grain size (Fig. 2), for studies on human toxicology and mechanical abrasion. These simulants are being produced under the direction of Marshall Space Flight Center (MSFC) and characterized in collaboration with the United States Geological Survey (USGS).

Specific lunar regolith properties can be addressed by addition of ilmenite, glassy agglutinates, nanophase iron, and other materials [3]. The fidelity of root simulants is thus increased by use of additives to form derivative simulants.

SLRS Materials Characterization: Fidelity and homogeneity of SLRS materials are important, on the scale of material supplied to the end user, and on the scale of a production run. Homogeneity is ensured for geochemical standards by fine grinding to reduce the grain size and chemical variability. Conversely, lunar simulants have a grain size variation and modal mineralogy at each size fraction that must be retained in order to match the target lunar regolith. Characterization of simulant is being conducted using bulk and micro analytical methods. Microprobe analysis of SLRS materials is being performed on polished mounts and particle mounts in order to compare conventional analyses with quantitative particle analysis correction methods. The SLRS and lunar soils typically exhibit lithic, mineral, and glassy components that persist to the finest grain sizes. These particles thus represent both homogeneous and complex particles and present challenges for both analysis and correction. Quantitative particle correction is currently being integrated with image / feature analysis methods typically available on turn-key systems.

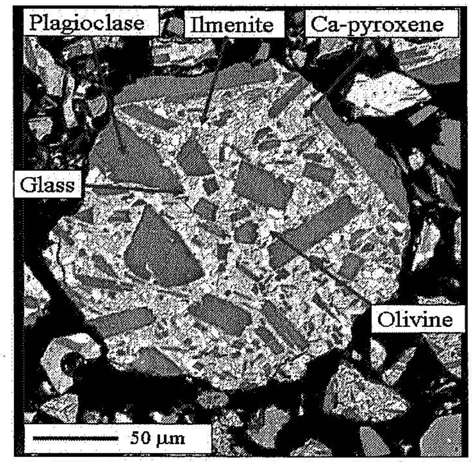

Fig. 1. BSE image of lunar simulant JSC-1 (polished mount).

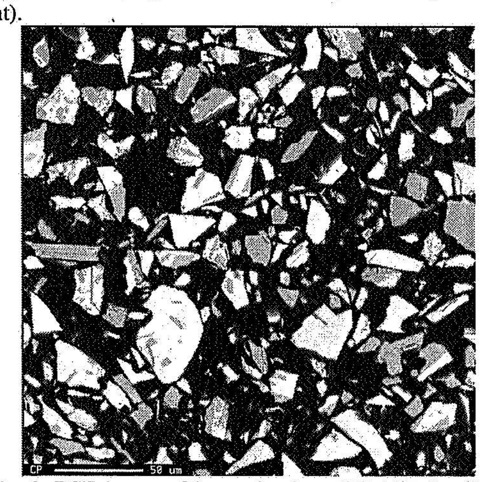
Fig. 2. BSE image of lunar simulant JSC-1AF fine fraction (polished mount). Grain size distribution of JSC-1AF has median size of ~ 25 μm from sieve analysis.

References: [1] Sibille L. et al., (2005) *Lunar Regolith Simulant Materials: Recommendations for Standardization, Production, and Usage*. NASA TP (*In preparation*, http://est.msfc.nasa.gov/workshops/lrsm2005.html). [2] Carter J., et al. (2004) Space Resources Roundtable VI, 15. [3] Taylor L. et al. (2004) Space Resources Roundtable VI, 46.